Recalcitrant Weeds in Ohio Vineyards

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ABSTRACT

A survey was conducted to document the weeds that persisted in vineyards after weed control practices were complete. A particular interest was detection of weeds potentially resistant to glyphosate. The survey was conducted throughout the state of Ohio by visiting 31 vineyards in 2004. Each grower provided us with an area ranging from 0.33 to several acres that they felt was representative of the general weed problems in the vineyards. Weed species and numbers were counted in 20 random drops of a 25×25 cm quadrat. Herbicide spraying history, grape varieties, vineyard locations, and grapevine age were collected by interviewing the growers and visiting the vineyards. Data were analyzed by SAS 9.1 using GLM model, and means were compared according to Student-Newman-Keuls (SNK) at the 0.05 level. Crabgrass, dandelion, pigweed, foxtail, fall panicum, clover, chickweed, common ragweed, smartweed, and oxalis were the most prevalent weeds in Ohio vineyards with relative abundance values of 44.2, 25.4, 17.7, 17.1, 14.3, 11.6, 11.3, 10.6, 10.3, and 9.3, respectively. When glyphosate was the sole means of management control of crabgrass, dandelion, and oxalis was poor, relative to control with other herbicide management programs. These data suggest that glyphosate resistance may be a potential problem in these weeds. The survey also showed that weed problems were more severe in *Vinifera* vineyards than in Concord and French hybrid vineyards. *Vinifera* vineyards require hilling of soil around the base of the vines in autumn to protect the graft union from winter injury and mechanical removal of the soil hill in spring (Figure 2).

INTRODUCTION

Ohio is one of the top 10 wine-producing states with more than 500,000 gallons produced every year (website of Ohio Grape Industries Committee). Along with diseases and insects, weeds are a big problem facing grapevine growers. Survey is an efficient way to get the general information on weed problems.

The objectives of this survey were to ***(1) determine which weeds persisted in vineyards after weed control practices were complete***, and ***(2) detect weeds which are potentially resistant to glyphosate.***

METHODS

❖ Vineyard selection, visiting and data collection

In 2004, around ***90*** questionnaires on vineyard weed problems and weed management methods were sent out to grape growers in Ohio and we got ***36*** responses. We visited these 36 vineyards and selected ***31*** for data collection (Figure 1) .

Each grower provided us with an area ranging from 0.33 to several acres that they felt was representative of the general weed problems in the vineyards. Weed species and numbers were counted in 20 random drops of a 25×25 cm quadrat. Frequency, field uniformity, mean occurrence field density, relative abundance, were calculated according to Thomas's survey system (1985) for every weed species showing up in this survey.

❖ Data analysis

Data were analyzed by SAS 9.1 using GLM model, and means were compared according to Student-Newman-Keuls (SNK) at the 0.05 level. The main factors were herbicide management types, tillage practices (tillage or non-tillage), and geographic regions (Figure 1).

RESULTS

Table 1. Relative abundance, frequency, field uniform, mean field density, and mean occurrence field density of weeds in Ohio vineyards.

Weeds	Relative Abundance	Frequency	Field Uniform	Mean Field Density	Mean Occurrence Field Density
Crabgrass	44.2	83.9	34.0	51.4	61.3
Dandelion	25.4	87.1	28.2	16.7	19.1
Pigweed	17.7	45.2	13.2	19.1	42.2
Foxtail*	17.1	64.5	16.3	12.5	19.4
Fall panicum	14.3	58.1	10.8	12.0	20.7
Clover	11.6	51.6	12.6	6.0	11.7
Chickweed	11.3	41.9	9.8	9.0	21.5
Common ragweed	10.6	51.6	12.7	3.8	7.4
Smartweed	10.3	58.1	11.2	3.6	6.1
Oxalis or Wood sorrel	9.3	48.4	10.5	3.3	6.9
Barnyard grass	9.0	45.2	7.4	5.7	12.6
Plantain**	8.55	38.7	9.4	4.3	11.1
Annual bluegrass	8.5	29.0	5.3	8.7	30.0
Common lambsquarter	7.8	45.2	6.9	3.6	7.9
Quackgrass	7.7	25.8	7.7	5.8	22.6
Prickly sida	7.4	22.6	4.5	8.2	36.1
Dock	6.0	38.7	4.0	3.2	8.3
Purslane	5.8	22.6	7.1	3.0	13.1
Yellow nutsedge	5.6	35.5	4.4	2.6	7.3
Virginia copperleaf	4.7	29.0	4.4	1.7	5.8
Canada thistle	4.5	25.8	4.4	1.8	6.8
Ground ivy	4.3	25.8	4.0	1.7	6.4
Groundsel	4.0	16.1	4.5	2.3	14.1
Indian tobacco	3.9	19.4	3.6	2.2	11.3
Horsenettle	3.6	29.0	2.7	0.7	2.5
Nimblewill	3.5	16.1	1.9	3.1	19.4
Red sorrel	3.1	19.4	1.9	1.8	9.1
Carpetweed	2.4	16.1	2.3	0.7	4.5
Eastern black nightshade	2.2	12.9	1.5	1.4	10.8
Knotweed	2.2	19.4	1.6	0.3	1.3
Sowthistle	2.0	12.9	1.9	0.6	4.6
Pokeweed	1.5	12.9	1.0	0.3	2.0
Wild carrot	1.4	12.9	1.0	0.2	1.4
Marestail or Horseweed	1.3	12.9	0.7	0.2	1.6
Morninglory	1.3	6.5	1.8	0.3	5.2
White campion	1.3	9.7	1.1	0.3	3.2
Galinsoga	1.2	9.7	0.7	0.4	4.5
Bramble	1.1	9.7	0.8	0.2	2.1
Honeyvine milkweed	1.1	9.7	0.8	0.2	2.1
Shepherd's purse	1.1	6.5	1.0	0.5	7.2
Hemp dogbane	1.0	9.7	0.7	0.1	1.1
Spurge;	1.0	9.7	0.7	0.1	1.1
Mustard	1.0	9.7	0.5	0.2	1.9
Devil's beggars-tick	1.0	9.7	0.5	0.1	1.3
Velvetleaf	0.8	6.5	0.3	0.4	6.4
Speedwell	0.8	6.5	0.7	0.2	2.4
Bindweed	0.8	6.5	0.7	0.1	1.6
Buttercup	0.8	3.2	1.0	0.3	9.6
Aster	0.7	6.5	0.5	0.1	1.6
Wirestem muhly	0.7	3.2	0.3	0.7	22.4
Groundcherry***	0.7	6.5	0.3	0.1	1.2
Cinquefoil	0.7	6.5	0.3	0.1	0.8
Wild buckwheat	0.3	3.2	0.2	0.0	0.8

*, Giant, yellow or green; **, Broadleaf or buckhorn; ***, Smooth or clammy

➢ Crabgrass, dandelion, pigweed, foxtail, fall panicum, clover, chickweed, common ragweed, smartweed, and oxalis were the most prevalent weeds in Ohio vineyards with relative abundance values of 44.2, 25.4, 17.7, 17.1, 14.3, 11.6, 11.3, 10.6, 10.3, and 9.3, respectively (Table 1).

Table 2 Effects of herbicide management program on weed density of 20 main weed species in Ohio vineyards.

Weeds	Weed Density (plants/m^2)			
	Non-chemical	Glyphosate	Paraquat + Residual¶	Glyphosate + Residual¶
Annual bluegrass	2.9 a*	3.0 a	15.4 a	16.8 a
Barnyard grass	12.5 a	6.6 a	0a	2.4 a
Crabgrass	18.7 b	95.8 a	10.1 b	33.9 b
Chickweed	1.4 a	13.8 a	0a	9.6 a
Clover	4.6 a	10.1 a	0a	4.0 a
Common ragweed	5.6 a	3.8 ab	0 b	3.5 ab
Dock	1.1 a	8.3 a	0a	0.2 a
Dandelion	11.8 b	36.8 a	0.8 b	2.9 b
Fall panicum	1.1 a	27.2 a	5.3 a	4.8 a
Foxtail	9.6 b	6.6 b	40 a	14.9 b
Lambsquarter	2.9 a	2.2 a	0a	5.8 a
Oxalis	3.8 ab	5.8 a	0 c	1.4 bc
Pigweed	51.2 a	7.7 b	0 b	16.5 b
Plantain	4.8 b	4.8 b	23.2 a	0.5 b
Prickly sida	0.8 a	1.0 a	0a	19.8 a
Purslane	0 b	6.2 a	0 b	1.9 b
Quackgrass	27.8 a	0.5 b	4 b	0 b
Smartweed	7.5 a	1.4 bc	0 c	4.2 ab
Virginia copperleaf	0.48 a	3.7 a	0a	0.8 a
Yellow nutsedge	0.48 a	1.0 a	5.6 a	4.6 a

¶ Residual herbicide = Simazine or Diuron or Dichlobenil
* Means followed by different letters are significantly different according to SNK test (P<0.05)

➢ Glyphosate alone provided lower weed control of crabgrass, dandelion, oxalis and purslane than other herbicide management programs (Table 2).

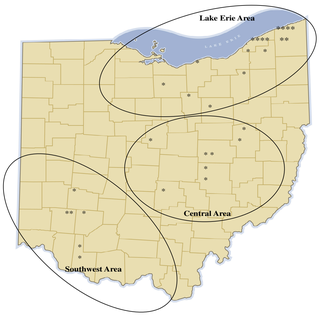
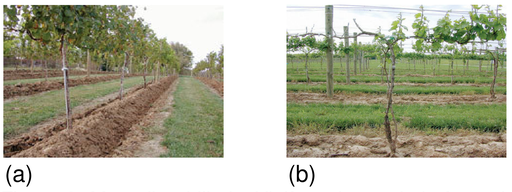


Figure 1. Geographical distribution of surveyed vineyards across Ohio

➢ There were more quackgrass and smart weed in Lake Erie Area, more clover and dandelion in Central Area, and more crabgrass and fall panicum in Southwest Area in Ohio (data not shown).



(a) (b)

Figure 2. Mounding hills in *Vinifera* vineyards before winter (a) and No hills in *Vinifera* vineyards during growing seasons (b)

Table 3 Weed density in *Vinifera* (hilled) and non-*Vinifera* (non-hilled) vineyards

Weeds	Weed Density (plants/m^2)	
	Vinifera (Hilled)	Non-*Vinifera* (non-hilled)
Barnyard grass	13.4 a*	2.6 b
Crabgrass	17.8 b	65.1 a
Foxtail	7.2 b	14.6 a
Groundsel	6.4 a	0.6 b
Hemp dogbane	0.3 a	0 b
Knotweed	0.6 a	0.2 b
Lambsquarter	7.8 a	1.8 b
Oxalis	6.2 a	2.1 b
Pigweed	33.9 a	12.5 b
Purslane	0.6 b	3.8 a
Quackweed	13.4 a	2.7 b
Smartweed	5.4 a	2.9 b
Sowthistle	1.6 a	0.2 b
White campion	1.0 a	0 b

* Means followed by different letters are significantly different according to SNK test (P<0.05)

➢ Fourteen weed species showed significant differences between *Vinifera* (hilled) and non-*Vinifera* (non-hilled) vineyards. There were 11 weed species out of 14 with a higher density in hilling vineyards (Table 3).

CONCLUSIONS

❖Crabgrass, dandelion, pigweed, foxtail, fall panicum, clover, chickweed, common ragweed, smartweed, and oxalis were the10 most recalcitrant weeds in Ohio vineyards.

❖Crabgrass, dandelion, oxalis and purslane were potentially glyphosate resistant species.

❖The hilling practice in Vinifera vineyards caused heavier weed problems.

REFERENCE

Thomas, A.G. 1985. Weed survey system used in Saskatchewan for cereal and oilseed crops. Weed Science 33, 34-43.